Harris County Public Health
Building a Healthy Community

Extreme Heat and Health Vulnerability Assessment Methodology

The Heat and Health Vulnerability Assessment (HHVA) combined exposure, sensitivity, and adaptive variables to create a single index representative of the overall heat risk faced by Harris County communities. The exposure, sensitivity, and adaptive components of the HHVA were weighted equally, as was each variable within the respective components. Exposure includes the degree to which the stressor is present in the community. In this case, exposure contained two variables. The first variable is the maximum annual heat index averaged over the 5-year period from 2011 to 2016. The second exposure variable is nighttime cooling. The sensitivity index, which included 11 demographic and health related variables in the assessment, represents the degree to which a community is likely to suffer increased adverse effects from a given level of exposure. The adaptive capacity index included 3 variables and represents the degree to which a community is able to mitigate the adverse effects of exposure.

Exposure	Average maximum heat index from 2011-2016
	Night-time cooling
Sensitivity	Percentage of adults with diabetes
	Percentage of adults with cardiovascular disease
	Percentage of adults with asthma and/or COPD
	Percentage of population living below the poverty line
	Population greater than 65 years of age
	Population less than 5 years of age
	Percent of population with limited English proficiency
	Percent of employed population that work outdoors
	Percent of population that identify as black, indigenous, people of color, and/or Hispanic.
	Percent of population without health insurance
	Percent of population with disability
Adaptive Capacity	Percentage of households without air conditioning
	Distance from census tract to nearest cooling center
	Percentage of tree canopy coverage

All variables underwent min-max normalization (below) that produced a standardized value between 0 and 1 in order to remove units and improve comparisons between data types.

$$Normalized\ Rank = \frac{Value - minimum}{Maximum - Minimum}$$

Each component index was created by summing the normalized ranks for all variables contained within it, dividing by the number of variables present and conducting min-max normalization on the resulting raw

score. One census tract, had less than 5 residents, resulting in a number of extreme values, so it was removed from the analysis entirely to avoid biasing the results. Two census tracts, 48201312100 and 48201412100, were missing data for one sensitivity and one adaptive capacity variables each. These census tracts were limited to Rice University and the University of Houston campuses and as such were likely not represented by the surrounding neighborhoods making the use of substitute values problematic. Dividing the component sum by the number of variables present was introduced as a way to control for the missing data. Three census tracts (48201543100, 48201253300, and 48201254700) were missing heat indexes. As this was the only variable in the exposure component, it could not be removed, and the missing heat indexes were substituted with the average heat index of adjacent census tracts. The normalized rank for distance to nearest cooling center was inverted by subtracting the original normalized rank from one. This step was to ensure that all three adaptive capacity variables would be on the same scale, where a larger score indicates greater adaptive capacity.

$$HVI = Exposure + Sensitivity - Adaptive\ Capacity$$

The vulnerability score itself is the normalized raw score which captures the calculated sum of the exposure index plus the sensitivity index minus the adaptive capacity index.